

Coll. Antropol. **25** (2001) 1: 255–262
UDC 616.717.4-001.5
Original scientific paper

Treatment of Supracondylar Humerus Fractures in Children: Minimal Possible Duration of Immobilization

Š. Vučkov¹, A. Kvesić², Z. Rebač², D. Cuculić¹, F. Lovasić¹ and N. Bukvić¹

¹ Department of Pediatric Surgery, University Hospital Center, University of Rijeka, Rijeka, Croatia

² Department of Surgery, University Hospital Center, University of Mostar, Mostar, Bosnia and Herzegovina

ABSTRACT

In the period from January 1980 until December 1990 we treated 147 children and adolescents with supracondylar humerus fracture, and followed the outcome in 127 of them. Three (2.4%) patients had no displacement of fractured bones and were treated only with plaster cast immobilization. Twenty three (18.1%) underwent closed reduction of fragments and application of a plaster cast. The majority (97; 76.4%) required manual reduction and the fixation of segments with Kirschner's wires laterally and medially. Four (3.1%) patients were treated with open reduction and fixation with Kirschner's wires. Both plaster cast immobilization and fragment fixation with Kirschner's wires lasted only 14 days and were immediately followed by rehabilitation. Such a short immobilization of extremities or fixation of fragments did not result in any complication. Of 56 children available for long-term follow-up, we achieved excellent treatment results in 43 (76.6%) of the patients, good and fair in 12 (21.5%), and a poor result in only 1 patient (1.8%). There were no permanent vascular or neurological complications apart from slight weakness of the ulnar nerve in 3 patients. In conclusion 14 days seemed to be the biological minimum of time needed for this type of fracture to heal in children and adolescents. Fixation of the fragments with Kirschner's wires and immobilization of the extremity for only 14 days brings a significant reduction of total treatment expenses, avoids repeated x-ray examination, facilitates early physical therapy and returns the child to its family.

Introduction

Supracondylar humeral fracture is a frequent bone injury in children and adolescents^{1–3}. Numerous reports on this type of fracture address its surgical treatment, either conservative or more active^{4–12}.

Surgical management of fractures faces requirements other than accomplishing ideal anatomical and functional restitution of the extremity. There is a need for shortening hospital treatment and prolonged bone extensions are used less and less. Also, prolonged plaster cast immobilization of extremities causing muscular atrophy and joint stiffness joints are avoided due to subsequent long rehabilitation. Current approach to fractures is quick mobilization of the traumatized extremity, which leads to a more comfortable life and easier hygiene of the patient¹⁰. This is especially important for children and adolescents suffering from supracondylar humerus fracture^{9,10}. In this report we present our experiences with 127 patients with supracondylar humerus fracture with respect to applied treatment methods, duration of the fracture fixation with wires, early and late complications, as well as treatment results.

Materials and Methods

From January 1980 until December 1990, at the Department of Pediatric Surgery of the Rijeka University Hospital Center we treated 147 children and adolescents suffering from supracondylar humerus fracture. The region of Rijeka is a tourist area and 20 patients returned home soon after segment reduction to continue with the treatment at their local health institutions, so were lost to the follow-up.

Sex and age distribution, as well as the type of fracture in the patients (Table

1), were typical for supracondylar humerus fracture for this age.

TABLE 1
CHARACTERISTICS OF PATIENTS (N = 127)
WITH SUPRACONDYLAR HUMERUS FRACTURE

	N
Sex	
Boys	92 (72.4%)
Girls	35 (27.6%)
Age	
0–2	4 (3.1%)
3–5	30 (23.6%)
6–10	84 (66.1%)
11–15	8 (6.3%)
16–20	1 (0.8%)
Type of fracture	
Extension	121 (95.3%)
Flexion	6 (4.7%)
Side involved	
Right	50 (39.4%)
Left	77 (60.6%)

Gartland's classification¹³ of supracondylar humerus fracture was used to distinguish three types of fractures:

Type I: patients without displaced fracture and with no need for its reduction. Plaster cast was applied on the back of the extremity, with the elbow flexed in the right angle, and the forearm in the middle position.

Type II: patients with displaced fragments still in contact underwent a closed reduction. If three or four days after the reduction the position of fragments was satisfactory on a roentgenogram conservative treatment was ensured. If there was a fragment displacement, the fragments were fixed using transcutaneous segment fixation with Kirschner's wires.

Type III: patients with supracondylar humerus fracture with total fragment separation and shift. Some underwent conservative treatment, and others had a primary reduction and transcutaneous fixation of fragments with Kirschner's wires (active surgical treatment).

If fragments were replaced and brought into a congruent position but were unstable, they were fixed with Kirschner's wires.

X-ray of the arm was performed on the third or fourth and fourteenth day after the reduction. The immobilization lasted only 14 days for all patients. The plaster cast was then removed, Kirschner's wires taken out and physical therapy initiated.

Patients were classified into four groups according to the treatment method (Table 2):

- 1) patients with supracondylar humeral fracture without fragment displacement, who were treated only with plaster cast immobilization placed at the back;
- 2) patients who underwent closed reduction of fragments (conservative method);
- 3) patients with closed reduction and transcutaneous fragment fixation with Kirschner's wires; and 4) patients who underwent open reduction and fixation with Kirschner's wires.

Unlike fractures in adults, which are related to violent accidents or car crashes, children and adolescents usually fracture their arm after falling on the outstretched or flexed arm and there is usually no damage to other organs and systems or bone fractures of the contralateral extremity (Table 3).

TABLE 2
DISTRIBUTION OF PATIENTS ACCORDING TO THE TYPE OF FRACTURE
AND THE TREATMENT METHOD

Type of fracture ^a	Application of Plaster cast only	Closed reduction + application of plaster cast	Closed reduction + Kirschner-wire fixation	Open reduction + Kirschner-wire fixation	Total
I	3 (2.4%)	–	–	–	3 (2.4%)
II	–	17 (13.4%)	21 (16.5%)	3 (2.4%)	41 (32.3%)
III	–	6 (4.7%)	76 (59.8%)	1 (0.8%)	83 (65.3%)
Total	3 (2.4%)	23 (18.1%)	97 (76.4%)	4 (3.1%)	127 (100.0%)

^a Criteria of Gartland¹³

TABLE 3
OTHER INJURIES OF THE UPPER EXTREMITY IN 127 PATIENTS WITH SUPRACONDYLAR HUMERUS FRACTURES

	Radius	Ulna	Radius+ulna	Other injuries of the elbow	Supracondylar fracture of the contralateral humerus	Total
Ipsilateral	8	1	6	2	–	17 (13.4%)
Contralateral	–	–	1	–	1	2 (1.6%)
Total	8	1	7	2	1	19 (15.0%)

To evaluate the cosmetic and functional outcome of the treatment, we used the criteria established by Flynn and his coworkers (Table 4)¹⁴.

Results

More than half of the patients with the II and III type of fracture underwent a primary reduction and transcuteaneous fixation of fragments with Kirschner's wires (Table 2). In these patients, single surgical intervention was successful in keeping the fragment in the correct position. Other patients underwent the same treatment after unsuccessful conservative method, i.e., closed reduction and plaster cast immobilization (Table 2). We operatively reposed the fragment only after repeated unsuccessful closed reduction or after unsuccessful closed reduction and transcuteaneous fragment fixation with Kirschner's wires. Only 1 patient (0.8%) needed four closed reduction (Table 5). Three patients did not

need fragment reduction (fracture type I according to Gartland)¹³.

In the operative treatment, we used posterior, medial, or lateral approach to the fractured areas. There were no differences in the outcome of those approaches. The anterior approach to the fractured area was not used, and we did not perform extension in any of the patients.

Out of 127 of the patients, 56 were followed up for 8 to 18 years after the treatment. Seventy one patients did not respond to repeated written invitations for a checkup. During the last checkup we also examined the subjective attitude of the patient towards late complications of the fracture.

The majority (76.7%) of the patients followed up to 18 years had excellent treatment results (Table 6). Fair and poor outcome was observed only after closed reduction followed by Kirschner's wire fixation, but not in conservatively treated patients (Table 6).

TABLE 4
CRITERIA FOR THE AVALUATION OF THE OUTCOME OF SUPRACONDYLAR HUMERUS FRACTURES TREATMENT ¹⁴

Results		Cosmetic factor: Carrying angle loss (Degrees)	Functional factor: Motion loss (Degrees)
Satisfactory	Excellent	0–5	0–5
	Good	5–10	5–10
	Fair	10–15	10–15
Unsatisfactory	Poor	Over 15	Over 15

TABLE 5
NUMBER OF REDUCTION IN RELATION TO THE GARTLAND'S CRITERIA TYPE OF FRACTURE ¹³

Type of fracture (Gartland's grade)	Number of reduction				
	1	2	3	4	Total
II	29 (23.4%)	13 (10.5%)	–	–	42 (33.9%)
III	40 (32.3%)	34 (27.4%)	7 (5.6%)	1 (0.8%)	82 (66.1%)
Total	69 (55.7%)	47 (37.9%)	7 (5.6%)	1 (0.8%)	124 (100.0%)

TABLE 6
OUTCOME OF THE TREATMENT OF THE SUPRACONDYLAR FRACTURE OF THE HUMERUS
AFTER A FOLLOW-UP OF 8–18 YEARS.

Method of treatment	Outcome ^a				Total
	Excellent	Good	Fair	Poor	
Closed reduction + plaster cast	8 (14.3%)	2 (3.6%)	–	–	10 (17.9%)
Closed reduction + Kirschner-wire Fixation	35 (62.4%)	8 (14.3%)	2 (3.6%)	1 (1.8%)	46 (82.1%)
Total	43 (76.7%)	10 (17.9%)	2 (3.6%)	1 (1.8%)	56 (100.0%)

^a Criteria of Flynn et al ¹⁴

TABLE 7
LATE COMPLICATIONS IN PATIENTS ACCORDING TO THE TYPE OF TREATMENT

	Closed reduction + Plaster cast	Closed reduction + Kirschner-wire fixation	Total
Cubitus varus	0	9	9
Cubitus valgus	2	1	3
Neurological impairment			
radials	–	–	–
ulnaris	0	3	3
medianus	–	–	–
Motion loss of the elbow			
extension	0	2	2
flexion	2	9	11
Total	4	24	28

Early neuro-vascular complications in all patients were reversible, apart from 3 who presented a slight weakness of the ulnar nerve after the fracture treatment as permanent findings (Table 7). The same table presents late complications linked with therapeutical procedures relating to morphological (cubitus varus and cubitus valgus) and functional disorders (flexion and extension limitations of the elbow joint).

Discussion

The influence of authors^{3,15–17} advocating conservative treatment of bone trauma in children and adolescents is still dominant. Their fear of causing pos-

sible injury in the area of bone growth or injury to the soft tissues, nerves, and blood vessels, or of osteomyelitis² when applying a more active surgical treatment on children with bone trauma is over emphasized¹⁰. The biological possibility of remodeling of the child's bone after fracture coalescing is also overemphasised^{15–17}.

The possibilities of bone injury treatment are today the subject to exhaustive and comprehensive discussion^{18–26}. New treatment methods of bone injuries are discovered and defined and eventually performed on children, including the treatment of supracondylar humerus fracture^{10,27}. There is a discrepancy in the

attitudes towards the choice of the treatment method of these fractures, which can sometimes lead to exclusivism^{9,12,18,19,28,29}. Despite huge medical bibliography on the treatment of these fractures in children and adolescents, very little comparative studies on the success of different treatment methods have been done^{9,29,30}. We present a comparative analysis of 127 patients suffering from supracondylar humerus fracture treated by conservative or more active surgical procedure.

Repeated reduction can be explained by less aggressive surgical approach. Moreover this injury is usually admitted to a hospital as an emergency case, and all surgeons are not completely familiarized with the treatment of bone casualty, especially as far as this type of fracture is concerned. In a conservative approach to these fractures, it is often difficult to find the right measure of elbow flexion without imperiling blood circulation, and a more open angle of the elbow may cause a subsequent sliding of the distal humerus fragment toward the medial one. This *supracondylar dilemma*⁹ is not present in a patient who, after reduction, underwent fragment fixation with wires.

Of the 127 patients, 56 responded to our invitation for a repeated checkup after 8 to 18 years. Twenty eight patients had more or less pronounced late complications and expected further treatment. The remaining 71 patients probably did not have any complications because it can be expected that they would come to seek further treatment in case of anatomical or functional dissatisfaction with the treatment outcome. We saw all 127 patients 6 months after surgery, when most such problems would be detected. Therefore we think that those 71 patients presented no anatomical or functional disorders either. Here can be actually concluded »pars pro toto« considering that both the patients and their parents,

whose children reached full growth, are interested in the possible correction of the morphological deformity or of the functional disturbance. The rest of the more or less pronounced morphological and functional disorders are included in the estimation of the treatment success based upon the Flynn and coworker's criteria¹⁴. Obtained results correspond with those of other authors^{9,19,31}.

By the end of the observed period, almost every patient suffering from the fracture with distal fragment displacement underwent fragment fixation with Kirschner's wires. We favor a more active surgical treatment method of these bone fractures because we believe that the possibility of a repeated displacement of fragments can be thus avoided. Moreover, there is no need for elbow immobilization in acute flexion, repeated roentgenograms are avoided, while the Bauman or humero-ulnar angle, as well as the »carrying angle« can be easily and precisely established.

An important aspect of our treatment approach is short duration of extremity immobilization or fragment fixation only 14 days in all 127 patients. In this way, the mobilization of the elbow and physical therapy started exactly two weeks after the injury. None of the 127 patients had any further displacement of the reposed fragments. We believe this to be the lower limit of the biological minimum in children and adolescents with regard to the time needed for the fragments to fuse. Therefore there is no need for a longer immobilization of extremities or for the fixation of fragments with wires than the one performed on our patients (only 14 days). This is especially important for the well being of the children, who have hard time to be separated from their families, as well as to be limited in their physical activity.

REFERENCES

1. CARCASSONE, M., M. BERGOIN, H. HORNING, J. *Pediat. Surg.*, 7 (1972) 676. — 2. MAYLAH, D. J., J. J. FAHEY, J. A. M. A., 18 (1958) 220. — 3. Von-EKESPARRE, W., *Ann. Chir. Inf.*, 11 (1970) 213. — 4. ARINO, V. L., E. E. LLUCH, A. M. RAMIREZ, J. FERRER, L. RODRIGUEZ, F. BAIXAULI, J. *Bone Joint S.*, 59A (1977) 914. — 5. DIETZ, H. G., P. ILLING, P. P. SCHMITTENBECHER: *Extremitäten-Frakturen in Kindersalter* (Quintessenz Verlags GmbH, München, 1993). — 6. DODGE, H. S., J. *Bone Joint Surg.*, 54A (1972) 1408. — 7. ESTROM, J. A., A. M. PANKOVICH, M. T. KASSAB, J. *Bone Joint Surg.*, 57A (1975) 680. — 8. FOWLES, J. V., M. T. KASSAB, J. *Bone Joint Surg.*, 56B (1974) 490. — 9. PIRONE, A. M., H. K. GRAHAM, J. I. KRAJBICH, J. *Bone Joint Surg.*, 70A (1988) 641. — 10. PRÉVOT, J., J. P. METAIZEAU, J. N. LIGIER, P. LASCOMBES, E. LESUR, G. DAUTEL, Paris, *Encycl. M. E. D. Chir.*, 44 (1993) 1. — 11. WEILAND, A. J., S. MEYER, V. T. TOLO, H. L. BERG, J. MUELLER, J. *Bone Joint Surg.*, 60A (1978) 657. — 12. WILKINS, K. E., *Pediat. Orthop.*, 6 (1977) 110. — 13. GARTLAND, J. J., *Surg. Gynec. Obstet.*, 109 (1959) 145. — 14. FLYN, J. C., J. G. MATTHEWS, R. L. BENOIT, J. *Bone Joint Surg.*, 56A (1974) 263. — 15. BLOUNT, W. P.: *Fractures in children*. (Williams and Wilkins, Baltimore, 1955). — 16. PALMER, E. E., K. M. W. NIEMANN, D. VESELY, J. H. ARMSTRONG, J. *Bone Joint Surg.*, 60A (1978) 653. — 17. WATSON-JONES, R.: *Fractures and joint injuries*. (Livingstone, London, 1955). — 18. BELTRAN, J., Z. S. ROSENBERG, M. KAWELBLUM, L. MONTES, A. G. BERGAM, A. STRONGWATER, *Skel. Radiol.*, 23 (1994) 277. — 19. FLYNN, J. C., W. P. ZINK: *Fractures and dislocations of the elbow*. In: MacEWEN, G. D., J. R. KASSER, S. D. HEINRICH (Eds.) *Pediatric fractures: A practical approach to assessment and treatment*. (Williams and Wilkins, Baltimore, 1993). — 20. PIGGOT, J., H. K. GRAHAM, G. F. MCCOY, J. *Bone Joint Surg.*, 68B (1986) 577. — 21. RAY, S. A., J. P. IVORY, J. P. BEAVIS, *Injury*, 21 (1991) 103. — 22. SCHÜTZ, W., M. BÖRNER, *Unfallchir.*, 11 (1985) 17. — 23. SINGH, D., *Injury*, 23 (1992) 70. — 24. SMITH, L., J. *Bone Joint Surg. (AM)*, 42A (1960) 235. — 25. SPINNER, M., S. N. SCHREIBER, J. *Bone Joint Surg.*, 51A (1969) 1584. — 26. Van GEERTRUYDEN, J. P., P. G. VICO, *Acta Orthop. Belg.*, 62 (1996) 222. — 27. WILLIAMSON, D. M., W. G. COLE, *Injury*, 24 (1993) 249. — 28. FURRER, M., G. MARK, T. RÜEDI, *Injury*, 22 (1991) 259. — 29. IPPOLITO, E., R. CATERINI, E. SCOLA, J. *Bone Joint Surg.*, 68A (1986) 333. — 30. SUTTON, W. R., W. B. GREEN, G. GEORGOPOULOS, T. B. DAMERON, *Clin. Orthop.*, 278 (1992) 81. — 31. EL-AHWANY, M. D., *Injury*, 6 (1974) 45.

Š. Vučkov

Department of Pediatric Surgery, University Hospital Centre, University of Rijeka, 51000 Rijeka, Croatia

LIJEČENJE SUPRAKONDILARNIH PRIJELOMA HUMERUSA U DJECE: NAJMANJE MUGUĆE TRAJANJE REHABILITACIJE

SAŽETAK

U vremenu od siječnja 1980. do prosinca 1990. godine liječeno je na Odjelu za dječju kirurgiju KBC Rijeka 147 djece i mladih sa suprakondilarnim prijelomom humerusa i u promatranje je uzeto njih 127. Trojica od njih (2,4%) nisu imali pomak frakturnih ulomaka i liječeni su samo imobilizacijom ekstramiteta gipsanom udlagom. U njih 23 (18,1%) izvršena je uspješno zatvorena manualna repozicija ulomaka i imobilizacija gipsanom udlagom. U većine njih (97 bolesnika tj. 76,4%) bilo je potrebno izvršiti zatvorenu manualnu repoziciju ulomaka i uz to njihovu fiksaciju u korigiranom položaju Kirschnerovim žicama. Četvorica njih (3,1%) liječena su otvorenom repozicijom ulomaka i njihovom fiksacijom Kirschnerovim žicama. I fiksacione Kirschnerove žice i gipsana udloga ostavljeni su in situ u svih njih bez iznimno kroz 14 postredukcijskih dana, a nakon toga su odstranjeni i započinjalo se je s fizijatrijskim liječenjem. Uočeno

je da unatoč tako minimalnom trajanju fiksacije ulomaka i imobilizacije ekstremiteta nije niti u jednog bolesnika došlo do naknadnog pomaka ulomaka. Od 56 djece u kojih je postoperativno praćenje bilo dužeg vremenskog intervala utvrđeni su kontrolnim pregledom izvrsni rezultati u njih 43 (76,6%), dobri i osrednji u 12 (21,5%) a loši samo u jednog (1,8%). Niti u jednog od njih nije bilo vaskularnih niti neuroloških oštećenja vezanih uz kirurško liječenje, a samo je u trojice bila utvrđena prolazna slabost ularnog živca. Smatramo da je vrijeme od 14 dana biološki minimum potreban za srašćavanje ovakvih prijeloma u djece i mladih čime se troškovi liječenja smanjuju, izbjegava se višekratno ponavljanje rendgenskih kontrolnih pregleda, omogućuje se vrlo rano započinjanje fizijatrijskog liječenja i povratak ozlijeđenog u obitelj.